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Abstract

A REACTIVITY OSCILLATOR FOR SWIMMING-POOL REACTORS

M. Nuruddin Qazi
Pakistan Atomic Energy Commission

This paper describes in detail the development and testing of a very simple and reliable reactivity oscillator. Although it is particularly suited for swimming-pool reactors it can be used with other similar types of reactors either in the present form or with slight modifications. Its chief advantage is the ease and convenience in setting up and performing the actual experiment of amplitude transfer function measurement. The entire experiment of measuring the amplitude transfer function including the setting-up of the apparatus can be completed in about 4 1/2 hours which makes it particularly attractive as a teaching device. The device is capable of providing an infinitely adjustable frequency range from 0.01 c/s to over 100 c/s, which is achieved by using a variable speed DC motor coupled with a specially designed system of pulleys. The need for a long rotor shaft has been eliminated by the use of two selsyn servo motors which has resulted in considerable improvements. The reactivity oscillations have been achieved by oscillating the amount of cadmium from a minimum to a maximum. This has been accomplished by rotating an aluminum disc carrying symmetrically placed cadmium sheets over another stationary aluminum disc exactly similar to the former. The resulting fluctuations in the neutron density of the core are detected by an ionization chamber and displayed on an oscilloscope. A polaroid camera is used to record these fluctuations from the oscilloscope screen. This apparatus was used to measure the amplitude transfer function of the Pennsylvania State University Reactor.^{1/} The experimentally obtained amplitude transfer function plots were compared with those computed theoretically on IBM-7074 for various values of ℓ^* - the prompt neutron lifetime.

^{1/} This work was done for the Masters degree at The Pennsylvania State University, University Park, Pa., U.S.A.

In computing the theoretical results, a value of 0.008 was used for the parameter $\bar{\beta}$ - the total effective fraction of the delayed neutrons - based on the experimental determination in BSR-1 at the Oak Ridge National Laboratory. The prompt neutron lifetime in the Pennsylvania State University Reactor was thus found to be 65 micro-seconds.